

Listing of the Claims

1. An optical disk comprising;
a recording layer having servo tracks; and
a clock reference structure formed along the servo tracks, the clock reference structure permitting data marks to be written and re-written to the recording layer in data fields of indeterminate length, the reference clock structure permitting the generation of a clock reference signal which controls where first and second transition edges of data marks are written to the recording layer with sub-bit accuracy.
2. The optical disk as recited in claim 1, wherein the clock reference structure comprises a reference spatial frequency which is greater than a predetermined spatial frequency.
3. The optical disk as recited in claim 2, wherein the predetermined spatial frequency is the maximum spatial frequency detectable by a standard DVD-ROM reader.
4. The optical disk as recited in claim 2, wherein the clock reference structure comprises edges of grooves of the servo tracks which oscillate in-phase at an oscillation spatial frequency, the oscillation spatial frequency corresponding to the reference spatial frequency.
5. The optical disk as recited in claim 2, wherein the clock reference structure comprises edges of grooves of the servo tracks which oscillate substantially 180 degrees out-of-phase at an oscillation spatial frequency, the oscillation spatial frequency corresponding to the reference spatial frequency.
6. The optical disk as recited in claim 2, wherein the clock reference structure comprises pits formed along the servo tracks, the reciprocal of a

distance between centers of adjacent pits corresponding to the reference spatial frequency.

7. The optical disk as recited in claim 1, wherein a first optical transducer coupled to the clock reference structure generates a clock reference signal comprising a clock reference signal frequency.
8. The optical disk as recited in claim 7, wherein the first optical transducer coupled to data marks on the recording layer generates a data signal having a frequency spectrum in which all fundamental frequency components of the frequency spectrum are less than the clock reference signal frequency.
9. The optical disk as recited in claim 8, wherein a standard DVD-ROM reader can read the data marks but cannot detect the clock reference structure.
10. An optical disk recorder comprising:
 - an optical disk rotatably mounted on the recorder, the optical disk having a recording layer containing servo tracks;
 - a first optical transducer optically coupled to the recording layer of the optical disk, the first optical transducer following a servo track as the optical disk rotates;
 - a clock reference structure formed along the servo tracks providing data fields of indeterminate length, the clock reference structure causing the first optical transducer to produce a clock reference signal as the optical disk rotates;
 - means for recording data marks on the recording layer of the optical disk, wherein the data marks are recorded to include fundamental spatial frequencies less than a predetermined spatial frequency; and
 - a write clock which determines the placement of first and second transition edges of data marks on the recording layer of the optical disk with

sub-bit accuracy, the write clock being phase locked to the clock reference signal.

11. The optical disk recorder as recited in claim 10, wherein the predetermined spatial frequency is the greatest spatial frequency detectable by a standard DVD-ROM reader.
12. The optical disk recorder as recited in claim 10, wherein the servo tracks include grooves and the clock reference structure comprises edges of the grooves which oscillate in-phase.
13. The optical disk recorder as recited in claim 12, wherein data marks cause the first optical transducer to produce an unwanted data signal as the optical disk rotates, and the clock reference signal is separated from the unwanted data signal by detecting the clock reference signal using radial push-pull detection.
14. The optical disk recorder recited in claim 10, wherein the servo tracks include grooves and the clock reference structure comprises edges on the grooves which oscillate substantially 180 degrees out-of-phase.
15. The optical disk recorder recited in claim 14, wherein data marks cause the first optical transducer to produce and unwanted data signal as the optical disk rotates, and the clock reference signal is separated from the unwanted data signal by detecting the clock reference signal using split detection.
16. The optical disk recorder recited in claim 10, wherein the clock reference structure comprises pits formed along the servo tracks.

17. The optical disk recorder as recited in claim 10, wherein the data marks are positioned along the servo tracks according to a DVD-ROM standard.

18. The optical disk recorder as recited in claim 10, wherein the data marks are arbitrarily coded.

19. The optical disk recorder as recited in claim 10, further comprising a second optical transducer which is optically coupled to the data marks on the recording layer, the second optical transducer following a servo track as the optical disk rotates, the data marks causing the second optical transducer to produce a data signal as the optical disk rotates.

20. The optical disk recorder as recited in claim 19, wherein the first optical transducer comprises a first laser and a first objective lens and the second transducer comprises a second laser and a second objective lens.

21. The optical disk recorder as recited in claim 20, wherein a combination objective lens is both the first objective lens and the second objective lens.

22. The optical disk recorder as recited in claim 20, wherein a numerical aperture of the combination objective lens is adjustably controlled to be lower when reading data than when recording data.

23. The optical disk recorder as recited in claim 20, wherein a wavelength of the second laser is greater than a wavelength of the first laser.

24. An optical disk recorder for receiving an optical disk which is rotatably mountable on the recorder, the optical disk comprising a recording layer having servo tracks and a clock reference structure having a spatial frequency which is greater than a predetermined spatial frequency, the clock reference structure

being formed along the servo tracks and providing data fields of indeterminate length, the optical disk recorder comprising:

 a first optical transducer which can optically couple to a recording layer of the optical disk, the first optical transducer following the servo tracks as the optical disk rotates, the clock reference structure causing the first optical transducer to produce a clock reference signal as the optical disk rotates;

 means for writing data marks on the recording layer of the optical disk; and

 a write clock which determines the physical placement of first and second transition edges of data marks written on the recording layer of the optical disk with sub-bit accuracy, the write clock being phase locked to the clock reference signal.

25. The optical disk recorder as recited in claim 24, wherein the predetermined spatial frequency is the maximum spatial frequency detectable by a standard DVD-ROM reader.

26. The optical disk recorder as recited in claim 24, wherein the first optical transducer can detect higher spatial frequencies than an optical transducer of a standard DVD-ROM optical disk reader.

27. The optical disk recorder as recited in claim 24, further comprising a second optical transducer which can optically couple to the data marks on the recording layer, the second optical transducer following a servo track as the optical disk rotates, the data marks causing the second optical transducer to produce a data signal as the optical disk rotates.

28. The optical disk recorder as recited in claim 24, wherein the first optical transducer comprises a first laser and a first objective lens and the second transducer comprises a second laser and a second objective lens.

29. The optical disk recorder as recited in claim 28, wherein a combination objective lens is both the first objective lens and the second objective lens and the objective lens.

30. The optical disk recorder as recited in claim 29, wherein a numerical aperture of the combination objective lens is adjustably controlled to be lower when reading data than when recording data.

31. The optical disk recorder as recited in claim 29, wherein a wavelength of the second laser is greater than a wavelength of the first laser.

32. The optical disk as recited in claim 7, wherein the first optical transducer coupled to data marks on the recording layer generates a data signal having a frequency spectrum in which the clock reference signal frequency is within fundamental frequency components of the frequency spectrum.

33. The optical disk as recited in claim 32, further including means for optically separating the data from the clock reference signal.

34. (Amended) The optical disk as recited in claim 32, further including means for optically separating the clock reference signal from the [form the] data signal.

35. (Amended) An optical disk recorder comprising:

an optical disk having a recording layer containing servo tracks; [a recording layer having servo tracks;]

a clock reference structure formed along the servo tracks, the clock reference structure permitting data marks to be written and re-written to the recording layer in data fields of indeterminate length, the reference clock structure permitting the generation of a clock reference signal which controls

where first and second transition edges of data marks are written to the recording layer with sub-bit accuracy;

a first optical transducer coupled to the clock reference structure generating [a] the clock reference signal comprising a clock reference signal frequency; and

wherein the first optical transducer coupled to data marks on the recording layer generates a data signal having a frequency spectrum in which the clock reference signal frequency is within fundamental frequency components of the frequency spectrum.

36. An optical disk recorder comprising:

an optical disk rotatably mounted on the recorder, the optical disk having a recording layer containing servo tracks, the servo tracks comprising grooves;

a first optical transducer optically coupled to the recording layer of the optical disk, the first optical transducer following a servo as the optical disk rotates;

a clock reference structure comprising edges of the grooves which oscillate in-phase formed along the servo tracks, the clock reference structure providing data fields of indeterminate length, the clock reference structure causing the first optical transducer to produce a clock reference signal as the optical disk rotates;

means for recording data marks on the recording layer of the optical disk, wherein the data marks are recorded to include fundamental spatial frequencies less than a predetermined spatial frequency;

a write clock which determines the placement of data marks on the recording layer of the optical disk, the write clock being phase locked to the clock reference signal; and

wherein data marks cause the first optical transducer to produce an unwanted data signal as the optical disk rotates, and the clock reference signal

is separated from the unwanted data signal by detecting the clock reference signal using radial push-pull detection.

37. An optical disk recorder comprising:

an optical disk rotatably mounted on the recorder, the optical disk having a recording layer containing servo tracks, the servo tracks comprising grooves;

a first optical transducer optically coupled to the recording layer of the optical disk, the first optical transducer following a servo track as the optical disk rotates;

a clock reference structure comprising edges on the grooves which oscillate substantially 180 degrees out-of-phase formed along the servo tracks, the clock reference structure providing data fields of indeterminate length, the clock reference structure causing the first optical transducer to produce a clock reference signal as the optical disk rotates;

means for recording data marks on the recording layer of the optical disk, wherein the data marks are recorded to include fundamental spatial frequencies less than a predetermined spatial frequency;

a write clock which determines the placement of data marks on the recording layer of the optical disk, the write clock being phase locked to the clock reference signal; and

wherein data marks cause the first optical transducer to produce an unwanted data signal as the optical disk rotates, and the clock reference signal is separated from the unwanted data signal by detecting the clock reference signal using split detection.

38. An optical disk, comprising:

a recording layer having a servo track; and

a clock reference structure formed along the servo track, the clock reference structure permitting writing of data having data fields of indeterminate length on the recording layer, the clock reference structure permitting generation

of a clock reference signal used for writing of the data, the clock reference structure having a spatial frequency that is within the spatial frequency spectrum of the data.

39. The optical disk as recited in claim 38, wherein the data can be written on the recording layer in a substantially continuous data stream to permit substantially uninterrupted reading of the data from the recording layer by using the clock reference signal.

40. The optical disk as recited in claim 38, wherein the recording layer is without permanent sectoring fields situated between the data fields and the sectoring fields having synchronization information and track address information.

41. The optical disk as recited in claim 38, wherein the clock reference structure itself includes synchronization and track address information.

42. The optical disk as recited in claim 38, wherein the clock reference structure comprises edges of grooves of the servo track that oscillate in-phase.

43. The optical disk as recited in claim 38, wherein the clock reference structure comprises edges of grooves of the servo track that oscillate out of phase.

44. The optical disk as recited in claim 38, wherein the clock reference signal permits writing of the data on the recording layer with sub-bit accuracy relative to the clock reference signal.

45. The optical disk as recited in claim 38, wherein the recording layer and clock reference structure are implemented so that a standard DVD Read-only reader can read the data but cannot detect the clock reference structure.

46. The optical disk as recited in claim 38, wherein an optical transducer is coupled to the clock reference structure and generates the clock reference signal.

47. The optical disk as recited in claim 46, wherein the optical transducer is coupled to data marks on the recording layer and generates a data signal having fundamental frequency components that define a data frequency spectrum corresponding to the spatial frequency spectrum of the data on the recording layer.

48. An optical disk, comprising:

recording means having a servo track for permitting writing of data having data fields of indeterminate length; and

clock reference means associated with the servo track for permitting generation of a clock reference signal used for writing, the clock reference means having a spatial frequency that is within the spatial frequency spectrum of the data.

49. The optical disk as recited in claim 48, wherein the recording means permits data to be written on the recording layer in a substantially continuous data stream to permit substantially uninterrupted reading of the data from the recording means by using the clock reference signal.

50. The optical disk as recited in claim 48, wherein the recording means permits data to be written on the recording layer in either a continuous or discontinuous data stream.

51. The optical disk as recited in claim 48, wherein the recording means permits data to be written on the recording layer without permanent sectoring fields that are situated between the data fields, the sectoring fields having information pertaining to synchronization and track address information.

52. The optical disk as recited in claim 48, wherein the clock reference means encodes synchronization and track address information.

53. The optical disk as recited in claim 48, wherein the clock reference means comprises edges of grooves of the servo track that oscillate in-phase.

54. The optical disk as recited in claim 48, wherein the clock reference means comprises edges of grooves of the servo track that oscillate out of phase.

55. The optical disk as recited in claim 48, wherein the clock reference signal permits writing of the data on the recording means with sub-bit accuracy relative to the clock reference signal.

56. The optical disk as recited in claim 48, wherein a standard DVD Read-only reader can read the data from the recording means but cannot detect the clock reference means.

57. An optical disk, comprising:

a recording layer having a servo track without permanent sectoring fields with information pertaining to synchronization information;

a clock reference structure formed along the servo track and comprising edges of grooves of the servo track which oscillate in-phase at an oscillation spatial frequency, the oscillation frequency corresponding to a clock reference spatial frequency, the clock reference structure permitting writing of data marks

having data fields of indeterminate length on the recording layer, the reference clock structure permitting generation of a clock reference signal used for writing of the data, the clock reference structure having a spatial frequency that is within the spatial frequency spectrum of the data; and

wherein the recording layer permits writing of data in a substantially continuous data stream to permit substantially uninterrupted reading of the data from the recording layer by using the clock reference signal.

58. The optical disk as recited in claim 57, wherein the recording layer permits writing of data in either a continuous or discontinuous data stream to permit uninterrupted reading of the data from the recording layer.

59. The optical disk as recited in claim 57, wherein the clock reference structure itself includes synchronization and track address information.

60. The optical disk as recited in claim 57, wherein the clock reference signal permits writing of the data on the recording layer with sub-bit accuracy relative to the clock reference signal.

61. The optical disk as recited in claim 57, wherein the recording layer and clock reference structure are implemented so that a standard DVD Read-only reader can read the data but cannot detect the clock reference structure.

62. The optical disk as recited in claim 57, wherein an optical transducer is coupled to the clock reference structure and generates the clock reference signal.

63. The optical disk as recited in claim 62, wherein the optical transducer is coupled to data marks on the recording layer and generates a data signal having fundamental frequency components that define a data frequency

spectrum corresponding to the spatial frequency spectrum of the data on the recording layer.

64. An optical disk recorder, comprising:

an optical disk rotatably mounted on the recorder, the optical disk having a recording layer containing a servo track;

a first optical transducer optically coupled to the recording layer of the optical disk, the first optical transducer following a servo track as the optical disk rotates;

a clock reference structure formed along the servo track providing data fields of indeterminate length, the clock reference structure causing the first optical transducer to produce a clock reference signal as the optical disk rotates;

means for recording data on the recording layer of the optical disk, wherein the data is recorded to include fundamental spatial frequencies that define a spatial frequency spectrum;

a write clock being phase locked to the clock reference signal and used to determine the placement of data on the recording layer of the optical disk; and

wherein the clock reference structure has a spatial frequency that is within the spatial frequency spectrum of the data.

65. The optical disk recorder as recited in claim 64, wherein the data can be written on the recording layer by the recording means in a continuous data stream to permit uninterrupted reading of the data from the recording layer by using the clock reference signal.

66. The optical disk recorder as recited in claim 64, wherein the optical disk is without permanent sectoring fields situated between the data fields on the recording layer.

67. The optical disk recorder as recited in claim 64, wherein the clock reference structure itself includes synchronization and track address information and further comprising a means for decoding this information.

68. The optical disk recorder as recited in claim 64, wherein the servo track includes grooves and the clock reference structure comprises edges of the grooves which oscillate in-phase.

69. The optical disk recorder as recited in claim 64 wherein the data causes the first optical transducer to produce an unwanted data signal as the optical disk rotates, and the clock reference signal is separated from the unwanted data signal by detecting the clock reference signal using radial push-pull detection.

70. The optical disk recorder as recited in claim 64, wherein the servo track includes grooves and the clock reference structure comprises edges on the grooves which oscillate out-of-phase.

71. The optical disk recorder as recited in claim 64 wherein the data causes the first optical transducer to produce an unwanted data signal as the optical disk rotates, and the clock reference signal is separated from the unwanted data signal by detecting the clock reference signal using split detection.

72. The optical disk recorder recited in claim 64, wherein the clock reference structure comprises pits formed along the servo tracks.

73. The optical disk recorder as recited in claim 64, wherein the data includes data marks that are positioned along the servo track according to a DVD Read-only standard.

74. The optical disk recorder as recited in claim 64, wherein the data includes data marks that are arbitrarily coded.

75. The optical disk recorder as recited in claim 64, further comprising a second optical transducer which is optically coupled to the data on the recording layer, the second optical transducer following the servo track as the optical disk rotates, the data causing the second optical transducer to produce a data signal as the optical disk rotates.

76. The optical disk recorder as recited in claim 75, wherein the first optical transducer comprises a first laser and a first objective lens and the second transducer comprises a second laser and a second objective lens.

77. The optical disk recorder as recited in claim 76, wherein a combination objective lens comprises both the first objective lens and the second objective lens, wherein a numerical aperture of the combination objective lens is adjustably controlled to be lower when reading data than when recording data.

78. The optical disk recorder as recited in claim 76, wherein a wavelength of the second laser is greater than a wavelength of the first laser.

79. The optical disk recorder as recited in claim 64, wherein the recording means is capable of writing data on the recording layer with sub-bit accuracy.

80. The optical disk recorder as recited in claim 64, further including means for separating the data from the clock reference signal.

81. An optical disk recorder, comprising:

(a) means for receiving an optical disk having:

(1) recording means having a servo track for permitting writing of data having data fields of indeterminate length; and

(2) clock reference means associated with the servo track for permitting generation of a clock reference signal used for the storage of the data, the clock reference means having a spatial frequency that is within the spatial frequency spectrum of the data; and

(b) means for determining the clock reference signal based upon the clock reference means; and

(c) means for writing data upon the servo track based upon the clock reference signal so that the spatial frequency spectrum of the data overlaps the spatial frequency of the clock reference means.

82. The optical disk recorder as recited in claim 81, wherein the means for writing data writes the data on the recording means in a continuous data stream to permit uninterrupted reading of the data from the recording means by using the clock reference signal.

83. The optical disk recorder as recited in claim 81, wherein the recording means is without permanent sectoring fields that are situated between the data fields and that have synchronization information and track address information.

84. The optical disk recorder as recited in claim 81, wherein the means for determining the clock reference signal can decode synchronization and track address information from the clock reference means.

85. The optical disk recorder as recited in claim 81, wherein the means for determining the clock reference signal can decode the clock reference means when defined as edges of grooves of the servo track that oscillate in-phase.

86. The optical disk recorder as recited in claim 81, wherein the means for determining the clock reference signal can decode the clock reference means when defined as edges of grooves of the servo track that oscillate out of phase.

87. The optical disk recorder as recited in claim 81, wherein the means for writing data can write data on the recording means with sub-bit accuracy relative to the clock reference signal.

88. A method, comprising the steps of:

detecting a servo track on an optical disk, the servo track comprising a recording layer and a clock reference structure;

generating a clock reference signal from the clock reference structure;
and

writing data having data fields of indeterminate length on the recording layer based upon the clock reference signal, the spatial frequency spectrum of the data overlapping the spatial frequency of the clock reference structure.

89. The method as recited in claim 88, wherein the data is written on the recording layer during the writing step in a continuous data stream to permit uninterrupted reading of the data from the recording layer by using the clock reference signal.

90. The method as recited in claim 88, further comprising the step of generating synchronization and track address information from the clock reference structure.

91. The method as recited in claim 88, wherein the clock reference structure comprises edges of grooves of the servo track that oscillate in-phase.

92. The method as recited in claim 88, wherein the clock reference structure comprises edges of grooves of the servo track that oscillate out of phase.

93. The method as recited in claim 88, wherein the step of writing data on the recording layer is performed with sub-bit accuracy relative to the clock reference signal.

94. The method as recited in claim 88, further comprising the steps of:
detecting with an optical transducer the clock reference structure to generate the clock reference signal; and
detecting with the optical transducer data marks on the recording layer;
and
generating a data signal having fundamental frequency components that define a data frequency spectrum corresponding to the spatial frequency spectrum of the data on the recording layer.

95. An optical disk, comprising:
a recording layer having a servo track; and
a clock reference structure formed along the servo track, the clock reference structure permitting writing of data having data fields of indeterminate length on the recording layer, the reference clock structure permitting generation of a clock reference signal which controls where first and second transition edges of data marks are recorded for the writing of the data with sub-bit accuracy.

96. An optical disk, comprising:

recording means having a servo track for permitting writing of data having data fields of indeterminate length; and

clock reference means associated with the servo track for permitting generation of a clock reference signal which controls where first and second transition edges of data marks are recorded for writing data with sub-bit accuracy.

97. An optical disk, comprising:

a recording layer having a servo track;

a clock reference structure formed along the servo track and comprising edges of grooves of the servo track which oscillate in-phase at an oscillation spatial frequency, the oscillation frequency corresponding to a clock reference spatial frequency, the clock reference structure permitting writing of data marks on the recording layer in data fields of indeterminate length, the clock reference structure permitting generation of a clock reference signal which controls where first and second transition edges of data marks are recorded for the writing of the data with sub-bit accuracy.

98. An optical disk recorder, comprising:

(a) means for receiving an optical disk having:

(1) recording means having a servo track for permitting writing of data having data fields of indeterminate length; and

(2) clock reference means associated with the servo track for permitting generation of a clock reference signal which controls where first and second transition edges of data marks are recorded for the writing of the data with sub-bit accuracy and which is used for the storage of the data; and

(b) means for determining the clock reference signal based upon the clock reference means; and

(c) means for writing data upon the servo track based upon the clock reference signal with sub-bit accuracy.

99. A method, comprising the steps of:

detecting a servo track on an optical disk, the servo track comprising a recording layer having a servo track and a clock reference structure;

generating a clock reference signal from the clock reference structure and which controls where first and second transition edges of data marks are recorded for the writing of the data with sub-bit accuracy; and

writing data having data fields of indeterminate length on the recording layer based upon the clock reference signal with sub-bit accuracy.

100. The optical disk as recited in claim 38, the clock reference structure further permitting re-writing of data having data fields and the clock reference signal further used for re-writing of the data.

101. The optical disk as recited in claim 44, wherein the clock reference signal further permits re-writing of the data of the data on the recording layer with sub-bit accuracy relative to the clock reference signal.

102. The optical disk as recited in claim 48, the recording means further permitting re-writing of data and the clock reference signal further used for re-writing data.

103. The optical disk as recited in claim 55, wherein the clock reference signal further permits re-writing of the data on the recording means with sub-bit accuracy relative to the clock reference signal.

104. The optical disk as recited in claim 57, the clock reference structure further permitting re-writing of data marks having data fields of indeterminate length on the recording layer, the reference clock structure further permitting generation of a clock reference signal used for re-writing of the data, and wherein the recording layer further permits re-writing of data in a substantially continuous data stream without edit gaps to permit substantially uninterrupted reading of the data from the recording layer by using the clock reference signal.

105. The optical disk as recited in claim 58, wherein the recording layer further permits re-writing of data in either a continuous or discontinuous data stream to permit uninterrupted reading of the data from the recording layer.

106. The optical disk as recited in claim 60, wherein the clock reference signal further permits re-writing of the data on the recording layer with sub-bit accuracy relative to the clock reference signal.

107. The optical disk as recited in claim 95, the clock reference structure further permitting re-writing of data having data fields of indeterminate length on the recording layer and the reference clock structure further permitting generation of a clock reference signal used for the re-writing of the data with sub-bit accuracy.

108. The optical disk as recited in claim 96, the servo track further permitting re-writing of data having data fields of indeterminate length and the clock reference signal further used for re-writing data with sub-bit accuracy.

109. The optical disk as recited in claim 97, the clock reference structure further permitting re-writing of data marks on the recording layer in data fields of indeterminate length and the clock reference signal further used for the re-writing of the data with sub-bit accuracy.